NASA Materials Related Lessons Learned

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Background

Lessons Learned have been the basis for our accomplishments throughout the ages. They have been passed down from father to son, mother to daughter, teacher to pupil, and older to younger worker. Lessons Learned have also been the basis for the nation's accomplishments for more than 200 years. Both government and industry have long recognized the need to systematically document and utilize the knowledge gained from past experiences in order to avoid the repetition of failures and mishaps.

Through the knowledge captured and recorded in Lessons Learned from more than 80 years of flight in the Earth's atmosphere, NASA's materials researchers are constantly working to develop stronger, lighter, and more durable materials that can withstand the challenges of space. The Agency's talented materials engineers and scientists continue to build on that rich tradition by using the knowledge and wisdom gained from past experiences to create futurist materials and technologies that will be used in the next generation of advanced spacecraft and satellites that may one day enable mankind to land men on another planet or explore our nearest star. These same materials may also have application here on Earth to make commercial aircraft more economical to build and fly.

With the explosion in technical accomplishments over the last decade, the ability to capture knowledge and have the capability to rapidly communicate this knowledge at lightning speed throughout an organization like NASA has become critical. Use of Lessons Learned is a principal component of an organizational culture committed to continuous improvement.

What are Lessons Learned?

Lessons Learned are the result of experiences with people, nature, and the products of our labors. The experiences may be positive, as in successful tests or missions, or negative, as in a mishap or failure. A Lesson Learned must be significant in that it has a real or assumed impact on operations, valid in that it is technically correct, and applicable in that it addresses a specific design process or decision that mitigates or eliminates the potential for failures, or reinforces a positive result.

The documentation of materials related Lessons Learned is important in order to convey information on usage experiences, test results, safety, and performance. Thus, they are an important and critical resource that can be used by materials engineers, scientists, and

technicians to support the design of flight and ground support hardware, facilities, and procedures.

Lessons Learned should communicate only lessons, and should not be used as a replacement for other management information functions like self-assessment, failure investigation and corrective actions systems.

How are Technical Standards and Lessons Learned Related?

As life becomes more complex, more guidance is needed. Technical Standards are the documents that infuse this guidance throughout the social structure. The scope of Technical Standards includes standards, specifications, guidelines, recommended practices, and handbooks. Technical standards are: (1) Systematic collections of proven guidance/methods/requirements (frequently gleaned from Lessons Learned) integrated into recommended practices, (2) Generally based on inputs from many activities combining the expertise of national or even international experts, and (3) The basic tools commonly used as the foundation for the normal design/development process. Technical Standards educate users, simplify information, and conserve experiences. They are the essential tools in the interaction of people with their environment. They enable us to intelligently pass on knowledge and associated Lessons Learned for others to build upon. Technical Standards are a very logical way to communicate Lessons Learned.

The Problem.

The Agency's materials engineers and specialists are constantly trying to improve the formulas of materials and with the "explosion" in technical accomplishments during the last few decades, the ability to rapidly communicate Lessons Learned, and the knowledge gained from them has become critical. This is especially true for activities associated with NASA's advanced Programs and Projects such as the Space Launch Initiative (SLI). The Agency's quest for affordable and routine access to space will require new generations of materials and material technologies, which will in turn enable the development of new reusable launch vehicles and associated spacecraft systems. Expecting the Agency's materials engineers to search through the ever-increasing number and contents of materials lessons learned databases have proven to be less than productive.

A Solution.

The "marriage" of Lessons Learned with current Technical Standards offers the opportunity for significant improvement in our goal to achieve advanced products and the use of current products. The NASA Technical Standards Program through the development and use of its Preferred Technical Standards database available to the Agency's users via the NASA Technical Standards Website (http://standards.nasa.gov) offers the foundation to accomplish this goal. Figure 1 shows the homepage of the NASA Technical Standards Program's Website.

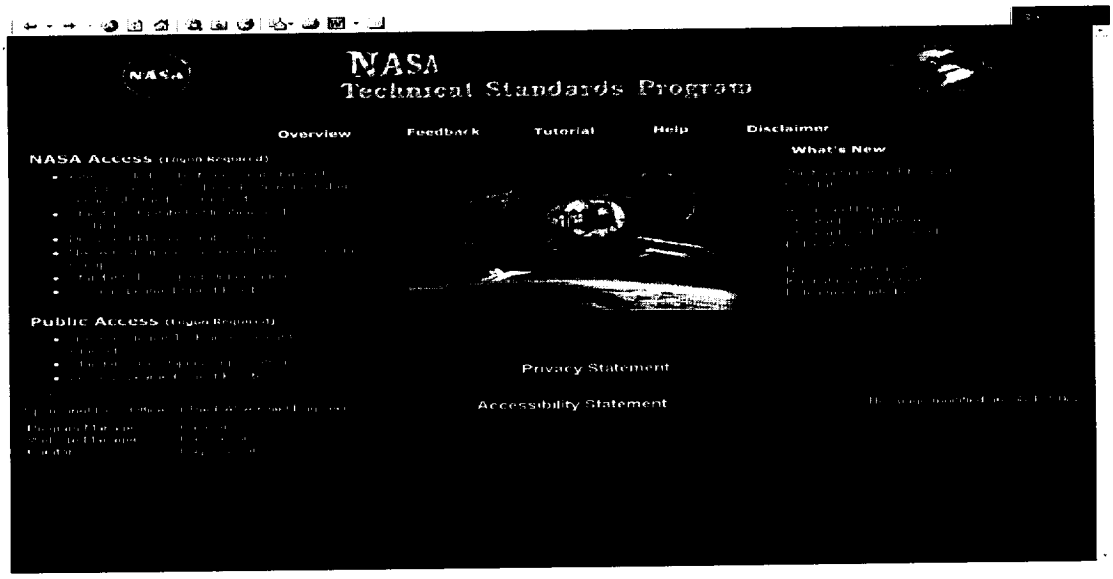

Figure 1. NASA Technical Standards Program Website

The Approach.

All NASA Programs/Projects are based on the application of Technical Standards, whether produced by NASA, other government organizations including DOD, or by non-Government standards developing organizations such as SAE, ASTM, ASME, and so on. These and other Technical Standards have gone through an extensive Agencywide review process pending their adoption/endorsement as NASA Preferred Technical Standards. Given this select database of Preferred Technical Standards, along with the existence of screened materials related lessons learned databases, a productive "marriage" is now readily possible. Figure 2 shows an example of the Document Summary Page with "linked" Lessons Learned.

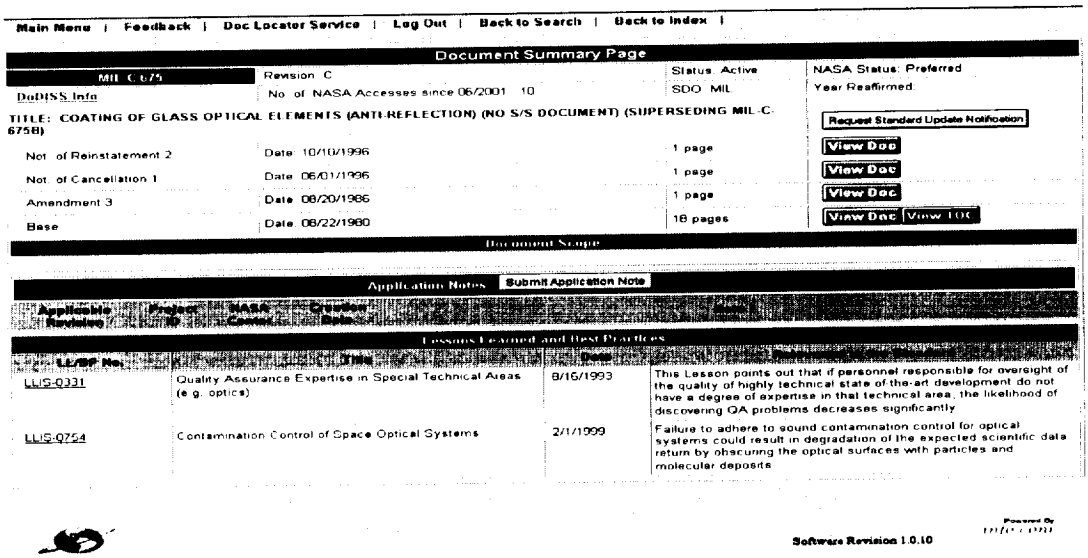

Figure 2. Document Summary Page with Linked Lessons Learned.

On the surface this "marriage" or linkage appears to be an easily achieved action. However, such is not the case. While the task is readily achievable, it requires the talents of dedicated and experienced engineers who must also possess the gifts of persistence

and meticulous attention to detail. The material involved must be read and interpreted and then correlated. The lessons learned databases that contain specific materials related lessons learned must be related to the NASA's Preferred Technical Standards database which currently has over 1500 entries. The result will be an invaluable database whereby any NASA Preferred Technical Standard related to materials and required for an Agency Program or Project design, development, or operations process will also have identified with it any relevant materials related lesson(s) learned.

Value.

NASA conscientiously investigates, documents, and tracks all of its successes and failures. Yet, all of this effort is meaningless if the Agency fails to incorporate these experiences into our ongoing and future Programs/Projects and their operations. They need a viable mechanism to identify and incorporate Lessons Learned into their design, development, and operations efforts, thus reducing mission risk. The cost of achieving the "marriage" of Lessons Learned and Technical Standards will be modest compared to the significant results that will be achieved. Only one Mission saved, or whose performance is enhanced, will repay the cost of developing this Integrated Technical Standards System many fold.

Gill, Paul S., William W. Vaughan, and Danny Garcia, "Lessons Learned and Technical Standards: A Logical Marriage". ASTM Standardization News, Vol. 29, No.11. November 2001.

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